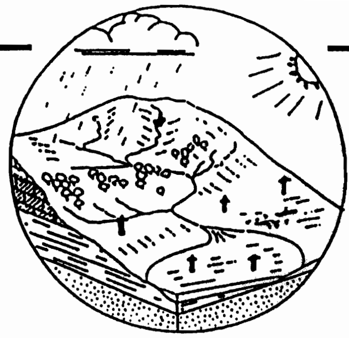
# Hydrological Summary for Great Britain



## JUNE 1992

### Rainfall

Only around 2/3 of average for GB but with a few notable thunderstorms early and late in the month. The drought affected area has extended well beyond the English lowlands but over the full compass of the drought, severity remains greatest in the east.

### River flows

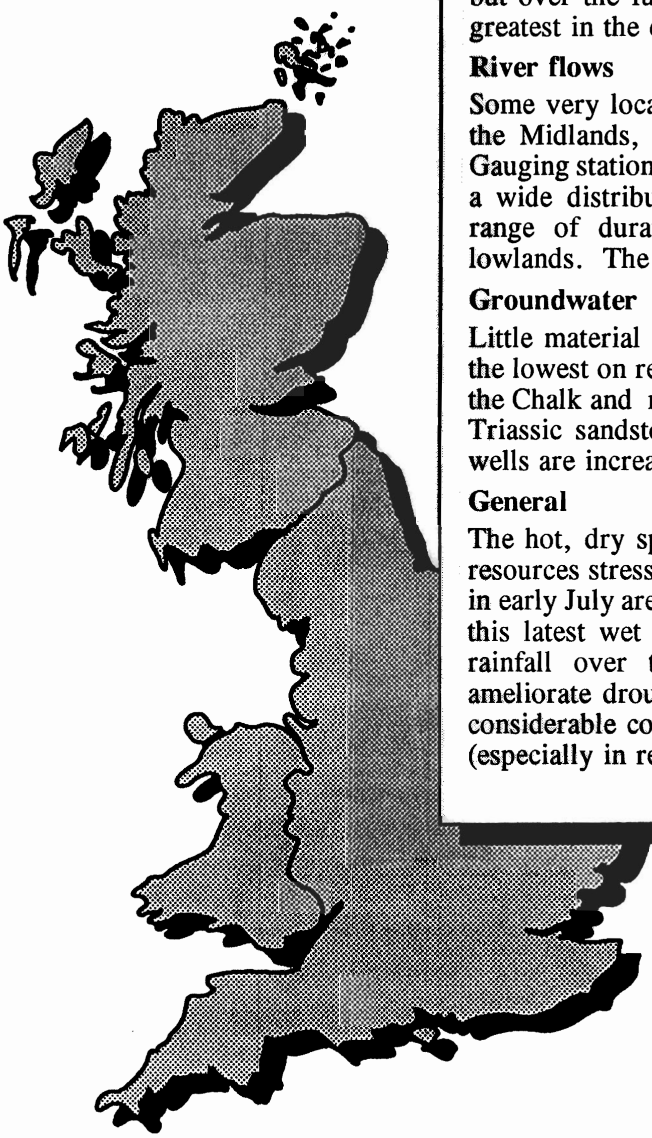
Some very localised flooding was reported but, away from the Midlands, monthly runoff totals were very depressed. Gauging stations recording new minimum June flows showed a wide distribution and accumulated runoff totals (over a range of durations) are unprecedented in much of the lowlands. The contraction of the river network continues.

### Groundwater

Little material change from May. Groundwater levels are the lowest on record (for early summer) throughout much of the Chalk and notably depressed in large parts of the Perms-Triassic sandstones also. Failures of springs and shallow wells are increasing.

### General

The hot, dry spell in June saw the region subject to water resources stress extend westwards. The unsettled conditions in early July are very welcome and usefully timed. However this latest wet episode will need to herald above average rainfall over the latter half of 1992 to significantly ameliorate drought conditions. A dry autumn would cause considerable concern regarding the water resources outlook (especially in relation to groundwater).



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# HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - June 1992

Data for this report have been provided principally by the regional divisions of the National Rivers Authority in England and Wales, the River Purification Boards in Scotland and by the Meteorological Office. Reservoir contents information has been supplied by the Water Services Companies, the NRA or, in Scotland, the Lothians Regional Council. The most recent areal rainfall figures are derived from a restricted network of raingauges (particularly in Scotland) and a proportion of the river flow data is of a provisional nature.

A map (Figure 4) is provided to assist in the location of the principal monitoring sites.

## Rainfall

June, like May, was an exceptionally warm month with high pressure dominating the weather for lengthy periods. Relatively few rain-bearing systems crossed the UK and much of Britain experienced a largely dry period from mid-April to late June but punctuated by several wet (in some districts notably so) interludes. The predominantly anticyclonic conditions in June encouraged convectional rainfall - a relatively rare commodity in recent years. Significant transport disruption and localised surface flooding was widely reported in the first ten days of June and again late in the month. Thundery conditions, were particularly prevalent in a broad corridor extending from Kent through London - where over 70 mm of rain fell in about two hours on the 9th in the Ravensbourne catchment - to north Wales.

Overall however June was a dry month and, in contrast to last year especially, rainfall was registered on very few days in most regions. The convectional character of much of the rainfall gave rise to marked local variations in monthly totals; inland from the Wash, for instance, some localities in Cambridgeshire had around three times the average whereas some districts in Lincolnshire had less than 10 mm. The temporal distribution was also unusual. Some eastern areas registered more than two-thirds of their monthly total on the first and last days of the month. Near-average June rainfall was largely confined to a broad belt extending across central England to mid-Wales. Notably low June totals were recorded in the northern Pennines and the Borders where Eskdalemuir recorded its lowest June rainfall in a record from 1911. Parts of the south-western England were very dry also - Culdrose in Cornwall recording only 1.3 mm.

Rainfall totals for 1992 are within the normal range in almost all regions but the dry, warm conditions since the late spring have seen drought conditions extend beyond the English lowlands, especially towards the South-West, triggering hose-pipe bans in some districts. Significant rainfall deficiencies may be identified in most regions of England and Wales over the period since July 1991 particularly in southern Britain. These confirm the shift in the focus of the short-term drought; in this timeframe rainfall deficiencies are most intense in the South-West and Southern regions. Generally, however, the drought is most severe within the 28-month timeframe. For England and Wales the period since February 1990 is the driest for ANY 28-month sequence since the 1780s (comparable accumulations occurred in the 1850s however) and the magnitude of the drought remains exceptional in East Anglia and the South-East. In relation to groundwater the long term deficiencies remain of greatest significance; return periods exceeding 50 years continue to characterise much of eastern and southern England in the four-year timeframe.

The return of a moist westerly airflow at the end of June, after an extended gap, was especially welcome as it terminated a very sustained dry spell (stretching up to 3 weeks in some areas). Some lowland areas recorded up to a tenth of their annual average rainfall over the week beginning on the 30th June. This unsettled spell will need to continue through July to help moderate water resources stress in the South-West, and herald a wet latter half of 1992 to provide the necessary basis for a substantial groundwater recovery over the winter.

**Evaporation and Soil Moisture Deficits (SMDs)**

Provisional temperature data suggest that June was the warmest since 1976 and the fourth warmest this century for England and Wales. Sunshine hours were also notably high. As a consequence PE rates were exceptional; actual evaporation losses were also well above average apart from lowland England where the dry soils considerably inhibited transpiration.

For the year thus far, PE rates are amongst the highest on record, typically eclipsed only by the January-June periods in 1976, 1989 and 1990. Soil moisture deficits increased very briskly from around the 3rd June in most areas and, approaching month-end were above average in all regions, SMDs exceeded 100 mm throughout much of eastern England and in coastal areas of the South-West. Unsettled conditions from the 30th produced some sharp declines in SMDs - up to 40 mm over the ensuing week in some areas. The moisture content of the lowland soils over the next six to eight weeks will be an important factor controlling the timing of the autumn recovery in runoff and recharge rates.

**River Flows**

Following healthy runoff - with isolated flooding - early in the month, rivers were in recession throughout much of June with some brisk but mostly short-lived recoveries reported around month end. Apart from the Midlands and parts of the South-East, most rivers registered a steep decline in monthly runoff totals relative to May. Some high flows were registered in a few impermeable lowland catchments (e.g. in London) but monthly runoff totals were well below average throughout a large majority of British catchments - typically in the range 40-60% of average. Gauging stations recording new minimum runoff totals for June exhibited a wide distribution - examples include the Dee (at Park), South Tyne, Yorkshire Derwent and Kent Stour. Throughout much of central, eastern and southern Britain, runoff was the lowest (for June) since the 1976 drought. However, flows were often not greatly different from those which have characterised the early summer for each of the previous three (in some areas, four) years. The more lengthy flow records for lowland rivers indicate that similar June runoff occurred in the early 70s, mid-60s and in the 1940s.

The hydrological severity of the present drought emerges more clearly when accumulated runoff totals are examined. Table 3 shows that new period-of-record minima have been established for many lowland (and some other) rivers over a range of durations - typically from 8 to >40 months; runoff over the last 12 months is often unprecedented in lowland rivers. For the two-year period beginning in July 1990, the accumulated runoff total is without parallel in a significant proportion of the index catchments. More significantly, in the two-year timeframe runoff totals from July 1990 are often below ANY 24-month accumulations on record. Such is the case on the Lud, Little Ouse and Itchen - for each of these rivers two-year flows are the lowest on record by an appreciable margin. Relatively few gauging station records extend back more than about 40 years. Those that do - for example the Lee and Thames - suggest that lower or similar 24-month runoff totals occurred during the droughts of the 1940s, 1933-35, 1901-03 and 1891/92. However, there is evidence that low flows at Feildes Weir (Lee) and Teddington Weir (Thames) may have been under-estimated before major improvements to the structures were completed (1951 on the Thames, mid-1970s on the Lee). Thus the current drought may well be more singular in its severity than a casual comparison may suggest. In eastern England it is now exceptionally protracted with many rivers, especially those sustained mainly from groundwater, remaining below average monthly flows for well over three years. With baseflows in decline further gentle recessions - and network contractions - are to be expected.

The drawdown in reservoir levels which began generally in late May accelerated in June as a consequence of very modest replenishment and, in some areas, increasing demand; heavy local demand created distribution problems in a few districts. In broad terms, stocks in lowland reservoirs (many of which are pumped storages) held up well and are, typically, similar to those of early July last year. In contrast relatively steep declines occurred in parts of south-western Britain (Wessex, the South-West and South Wales); in the latter region stocks were appreciably below those at the same time in 1991. Some useful replenishment occurred in early July and the water supply outlook for the late summer/early autumn will depend largely on rainfall over the next few weeks.

**Groundwater**

Heavy rainfall in late-May/early June provided a late (and modest) burst of infiltration - in some areas delaying the full onset of the summer recession. The consequential slight rises in groundwater level may be detected on a few index well traces (e.g. Llanfair DC). Useful though these upturns were, they are of very minor significance relative to the extremely depressed spring groundwater levels.

In a zone from southern Yorkshire through East Anglia and the Chilterns to eastern Kent, groundwater levels are near to, or beneath, seasonal minima. At the Washpit Farm Chilterns site, levels are the lowest on record for any month and throughout most of the eastern Chalk levels are below the early summer minima. Groundwater levels in the Chalk generally improve in a westerly direction (see Rockley, for example) but spatial variations in winter recharge were substantial and levels in some western Chalk wells are unprecedented for late-June (see for instance, Lime Kiln Way).

Levels in the Carboniferous Limestone (at Alstonfield) and the Jurassic Limestone (Ampney Crucis) remain within the normal range but levels in the Permo-Triassic sandstone aquifers are depressed over wide areas. In North Wales and the northern Midlands, the groundwater level at Llanfair DC is only marginally above the June minimum and the Weeford Flats site remains dry. Water-tables in parts of the South-West are also close to or below the lowest on record. In southern Scotland and north-west England, levels are near, or beneath, the seasonal mean and were generally falling throughout June. Nowhere are groundwater levels above seasonal mean values.

No replenishment to aquifers may be expected before October 1992 (at the earliest) in lowland areas. While recessions starting at low levels are usually much shallower than when starting at high levels, by the autumn groundwater levels will probably have fallen appreciably below the 1990 or 1991 level minima.

Groundwater resources are in a very fragile condition and the impact on well yields of the fall of levels into uncharted territory is difficult to predict; some decline in the yield of certain public water supply boreholes have been reported. Dwellings and small holdings dependent for water supplies upon shallow wells are particularly vulnerable. There have already been instances in 1992 of well (and spring) failures in the eastern Chalk but in the early summer of 1992 problems with shallow wells were reported over a wider area (for instance in the Wiltshire Downs, Worcestershire and South Wales).

By their nature, groundwater droughts tend to be persistent and with water-tables in the most severely affected areas standing below the early-summer average by the equivalent of twice the range between mean minimum and mean maximum monthly levels, no early termination is possible. Where the decline in water-tables has been accelerated by groundwater pumping, the outlook is even less encouraging. An exceptionally wet 1992-93 winter will be necessary to restore groundwater levels to their normal (pre-1990) state; a further dry winter will be a matter for serious concern.

**Institute of Hydrology/British Geological Survey**
**14 July 1992**

## TABLE 1 1991/92 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

| | | June | July | Aug | Sept | Oct | Nov | Dec 1991 | Jan 1992 | Feb | Mar | Apr | May | June |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| England and | mm | 93 | 68 | 31 | 62 | 77 | 95 | 49 | 47 | 41 | 70 | 75 | 49 | 45 |
| Wales | % | 153 | 93 | 34 | 75 | 93 | 98 | 54 | 55 | 64 | 119 | 129 | 73 | 74 |
| NRA REGIONS | | | | | | | | | | | | | | |
| North West | mm | 105 | 67 | 65 | 69 | 125 | 169 | 119 | 54 | 97 | 139 | 89 | 62 | 34 |
| | % | 127 | 65 | 52 | 56 | 106 | 140 | 99 | 48 | 120 | 193 | 116 | 76 | 47 |
| Northumbria | mm | 69 | 53 | 36 | 42 | 75 | 109 | 78 | 32 | 46 | 106 | 103 | 31 | 21 |
| | % | 113 | 69 | 36 | 53 | 100 | 116 | 104 | 30 | 70 | 204 | 187 | 48 | 34 |
| Severn-Trent | mm | 74 | 77 | 21 | 54 | 55 | 68 | 39 | 58 | 31 | 67 | 50 | 59 | 54 |
| | % | 132 | 118 | 26 | 81 | 85 | 86 | 56 | 84 | 58 | 129 | 96 | 92 | 96 |
| Yorkshire | mm | 73 | 36 | 21 | 40 | 63 | 94 | 62 | 46 | 41 | 89 | 66 | 34 | 43 |
| | % | 126 | 51 | 23 | 56 | 91 | 106 | 84 | 60 | 64 | 168 | 118 | 56 | 74 |
| Anglian | mm | 77 | 38 | 18 | 63 | 26 | 54 | 24 | 45 | 17 | 62 | 43 | 48 | 40 |
| | % | 157 | 67 | 28 | 121 | 50 | 87 | 45 | 86 | 39 | 155 | 108 | 102 | 82 |
| Thames | mm | 96 | 79 | 18 | 52 | 36 | 66 | 16 | 28 | 25 | 51 | 65 | 60 | 38 |
| | % | 185 | 132 | 26 | 84 | 56 | 90 | 24 | 45 | 53 | 111 | 141 | 107 | 73 |
| Southern | mm | 125 | 88 | 15 | 51 | 51 | 81 | 23 | 18 | 33 | 59 | 84 | 30 | 29 |
| | % | 250 | 149 | 21 | 72 | 65 | 86 | 28 | 24 | 58 | 113 | 175 | 55 | 58 |
| Wessex | mm | 107 | 73 | 19 | 71 | 83 | 72 | 30 | 36 | 39 | 55 | 81 | 24 | 51 |
| | % | 198 | 118 | 23 | 90 | 101 | 74 | 33 | 43 | 66 | 95 | 150 | 35 | 94 |
| South West | mm | 127 | 90 | 32 | 85 | 123 | 112 | 52 | 44 | 68 | 75 | 100 | 31 | 26 |
| | % | 195 | 107 | 32 | 82 | 109 | 84 | 39 | 34 | 76 | 89 | 141 | 37 | 40 |
| Welsh | mm | 111 | 97 | 54 | 85 | 154 | 142 | 65 | 75 | 79 | 114 | 91 | 80 | 51 |
| | % | 135 | 102 | 45 | 68 | 119 | 99 | 45 | 55 | 82 | 131 | 107 | 88 | 62 |
| Scotland | mm | 122 | 91 | 67 | 131 | 165 | 227 | 141 | 132 | 165 | 208 | 123 | 80 | 52 |
| | % | 133 | 81 | 52 | 96 | 111 | 160 | 90 | 96 | 159 | 226 | 137 | 88 | 56 |
| RIVER PURIFICATION BOARDS | | | | | | | | | | | | | | |
| Highland | mm | 125 | 105 | 86 | 182 | 193 | 305 | 166 | 180 | 225 | 250 | 138 | 105 | 62 |
| | % | 114 | 83 | 58 | 115 | 104 | 180 | 85 | 110 | 169 | 219 | 121 | 102 | 56 |
| North-East | mm | 131 | 57 | 34 | 58 | 120 | 133 | 53 | 67 | 51 | 119 | 68 | 57 | 51 |
| | % | 187 | 62 | 32 | 67 | 124 | 129 | 52 | 74 | 69 | 192 | 111 | 74 | 73 |
| Tay | mm | 135 | 93 | 40 | 111 | 155 | 154 | 97 | 109 | 106 | 159 | 90 | 57 | 42 |
| | % | 163 | 91 | 34 | 97 | 127 | 129 | 72 | 92 | 115 | 19 | 120 | 60 | 50 |
| Forth | mm | 110 | 97 | 38 | 103 | 111 | 124 | 108 | 108 | 110 | 129 | 76 | 45 | 32 |
| | % | 147 | 99 | 33 | 95 | 105 | 115 | 99 | 109 | 143 | 187 | 112 | 54 | 46 |
| Tweed | mm | 90 | 65 | 36 | 67 | 101 | 127 | 92 | 67 | 69 | 134 | 98 | 52 | 26 |
| | % | 132 | 73 | 32 | 71 | 115 | 122 | 102 | 72 | 100 | 231 | 161 | 68 | 38 |
| Solway | mm | 122 | 77 | 69 | 81 | 172 | 203 | 162 | 89 | 148 | 205 | 144 | 66 | 29 |
| | % | 136 | 70 | 53 | 54 | 119 | 140 | 107 | 64 | 159 | 225 | 164 | 72 | 32 |
| Clyde | mm | 129 | 108 | 87 | 157 | 193 | 274 | 208 | 165 | 234 | 274 | 144 | 93 | 46 |
| | % | 125 | 83 | 61 | 90 | 105 | 164 | 112 | 102 | 207 | 261 | 140 | 96 | 45 |

Note: The most recent monthly rainfall figures correspond to the MORECS areal assessments derived by the Meteorological Office. The regional areal rainfall figures are regularly updated (normally one or two months in arrears) using figures derived from a far denser raingauge network.

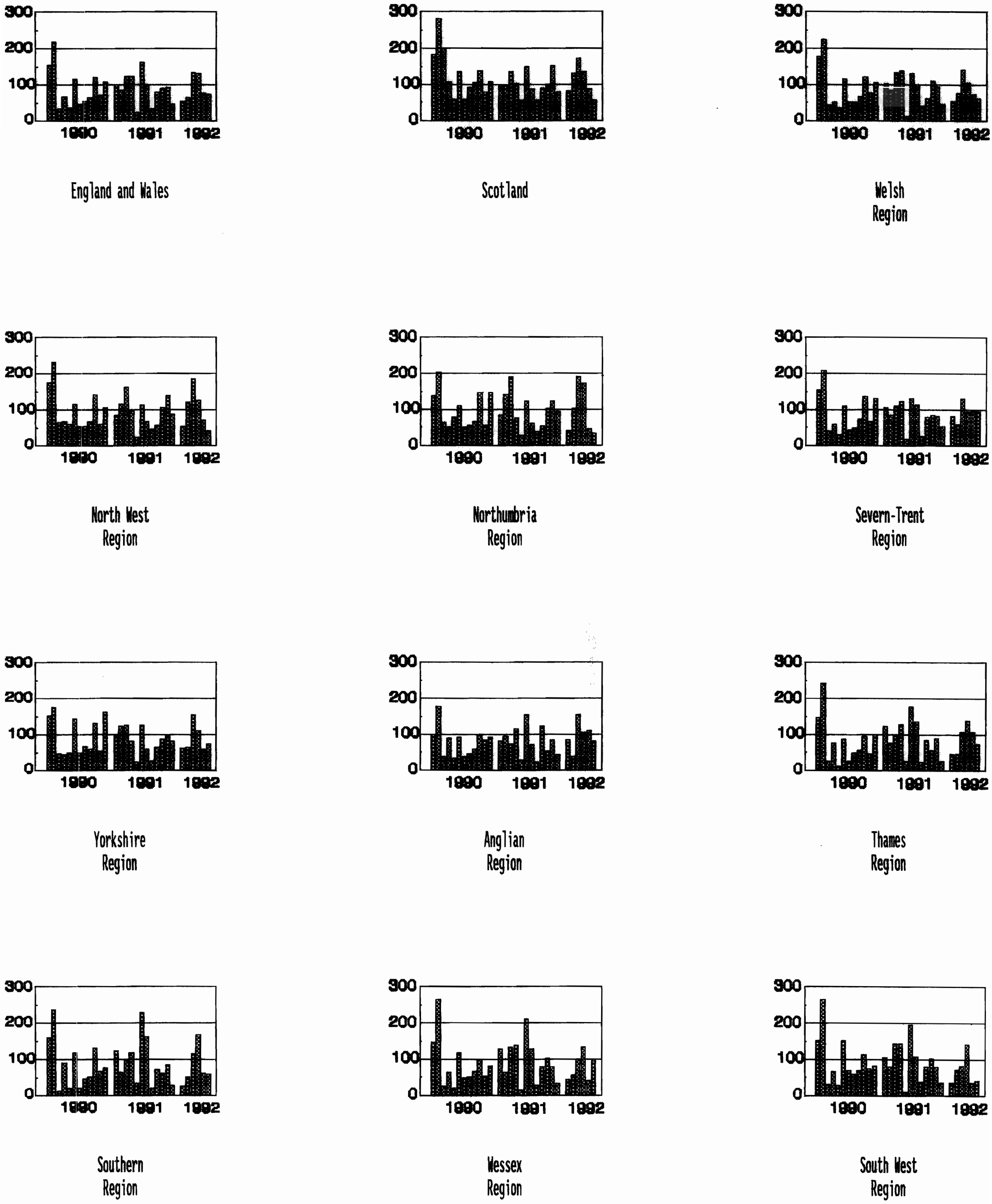
## TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

| | | Jan - Jun 92 | Est Return Period, years | Aug91-Jun92 | Est Return Period, years | Mar90-Jun92 | Est Return Period, years | Aug88-Jun92 | Est Return Period, years |
|---|---|---|---|---|---|---|---|---|---|
| England and | mm | 327 | | 641 | | 1680 | | 3094 | |
| Wales | % LTA | 83 | 5-10 | 76 | 20-35 | 81 | 60-90 | 87 | 35-50 |
| NRA REGIONS | | | | | | | | | |
| North West | mm | 475 | | 1022 | | 2447 | | 4435 | |
| | % LTA | 94 | 2-5 | 92 | 2-5 | 89 | 5-15 | 93 | 5-10 |
| Northumbria | mm | 339 | | 679 | | 1763 | | 2981 | |
| | % LTA | 90 | 2-5 | 85 | 5-10 | 89 | 5-15 | 87 | 30-40 |
| Severn Trent | mm | 319 | | 556 | | 1436 | | 2623 | |
| | % LTA | 92 | 2-5 | 79 | 10-20 | 81 | 40-60 | 87 | 20-30 |
| Yorkshire | mm | 319 | | 599 | | 1540 | | 2768 | |
| | % LTA | 86 | 2-5 | 79 | 10-20 | 81 | 40-60 | 85 | 40-60 |
| Anglian | mm | 255 | | 440 | | 1070 | | 1926 | |
| | % LTA | 94 | 2-5 | 80 | 10-20 | 77 | 120-170 | 81 | 150-250 |
| Thames | mm | 267 | | 455 | | 1216 | | 2277 | |
| | % LTA | 86 | 2-5 | 71 | 30-40 | 76 | 90-130 | 83 | 50-80 |
| Southern | mm | 253 | | 474 | | 1398 | | 2550 | |
| | % LTA | 75 | 5-10 | 64 | 80-120 | 78 | 60-80 | 82 | 70-100 |
| Wessex | mm | 286 | | 562 | | 1513 | | 2893 | |
| | % LTA | 76 | 5-10 | 70 | 30-40 | 77 | 70-90 | 85 | 30-40 |
| South West | mm | 344 | | 748 | | 2178 | | 4181 | |
| | % LTA | 66 | 20-30 | 67 | 60-90 | 81 | 35-50 | 89 | 10-20 |
| Welsh | mm | 491 | | 990 | | 2555 | | 4808 | |
| | % LTA | 85 | 2-5 | 80 | 10-20 | 85 | 15-25 | 92 | 5-10 |
| Scotland | mm | 760 | | 1491 | | 3603 | | 6380 | |
| | % LTA | 125 | 15-25 | 113 | 5-10 | 112 | 15-25 | 114 | 120-170 |
| RIVER PURIFICATION BOARDS | | | | | | | | | |
| Highland | mm | 960 | | 1892 | | 4431 | | 8079 | |
| | % LTA | 130 | 30-40 | 119 | 10-20 | 114 | 20-40 | 119 | >200 |
| North-East | mm | 413 | | 811 | | 2135 | | 3599 | |
| | % LTA | 95 | 2-5 | 87 | 5-10 | 92 | 5-10 | 90 | 10-20 |
| Tay | mm | 563 | | 1120 | | 2831 | | 5194 | |
| | % LTA | 103 | 2-5 | 97 | 2-5 | 99 | <2 | 106 | 5 |
| Forth | mm | 502 | | 986 | | 2564 | | 4614 | |
| | % LTA | 106 | 2-5 | 97 | 2-5 | 101 | 2-5 | 106 | 5-10 |
| Tweed | mm | 446 | | 869 | | 2167 | | 3714 | |
| | % LTA | 105 | 2-5 | 95 | 2-5 | 96 | 2-5 | 95 | 2-5 |
| Solway | mm | 681 | | 1368 | | 3213 | | 5823 | |
| | % LTA | 115 | 5 | 104 | 2-5 | 100 | <2 | 104 | 2-5 |
| Clyde | mm | 956 | | 1875 | | 4338 | | 7789 | |
| | % LTA | 140 | 80-120 | 122 | 20-30 | 116 | 30-40 | 119 | >200 |

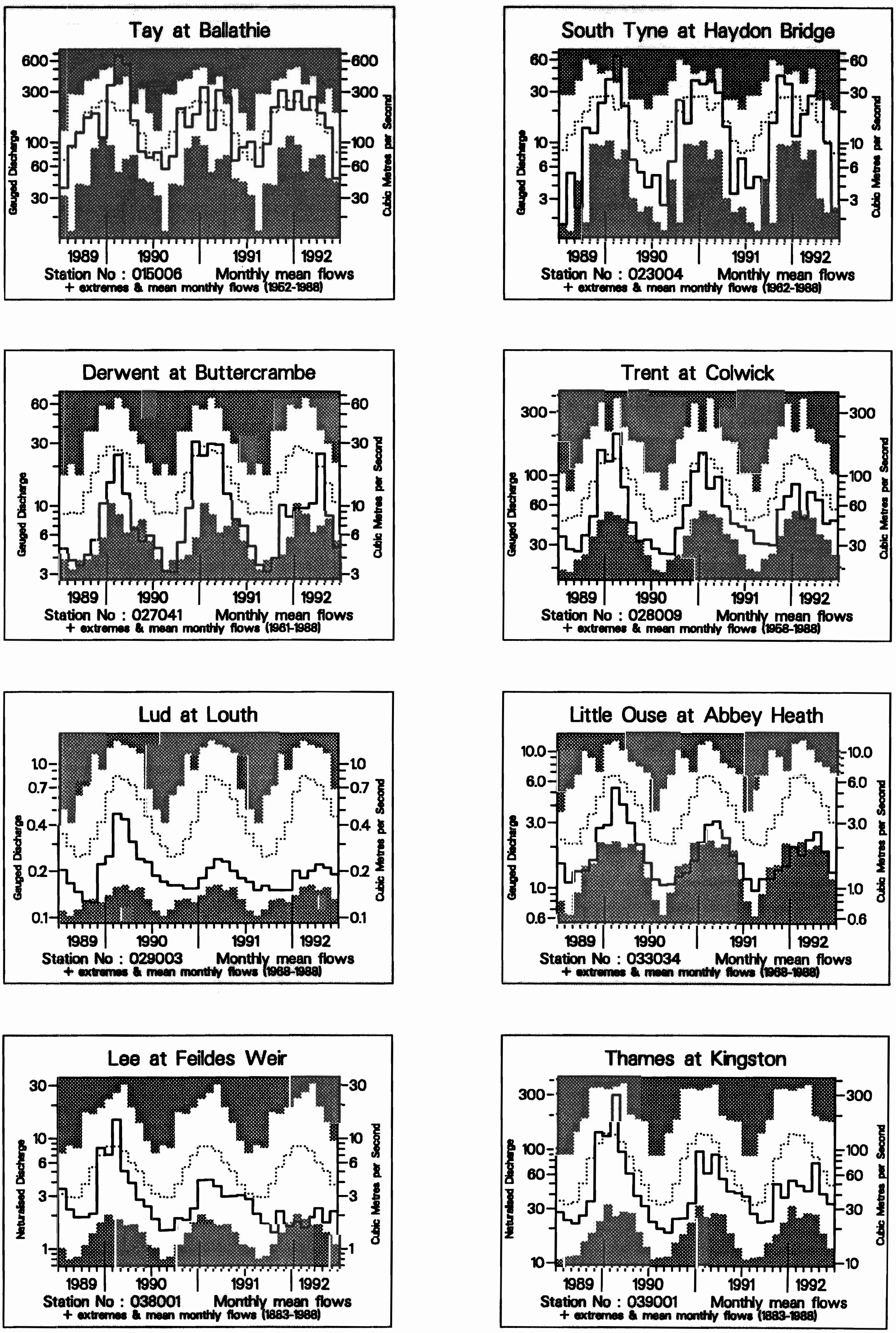
Return period assessments are based on tables provided by the Meteorological Office*. These assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less - for the longest durations the return period estimates converge. "Wet" return periods underlined.
The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate.

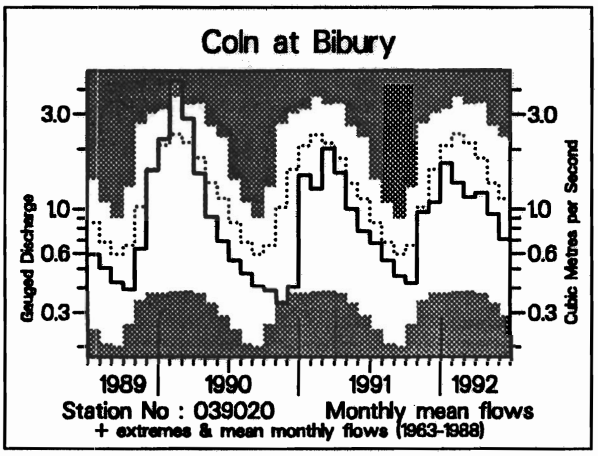
* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office (HMSO).

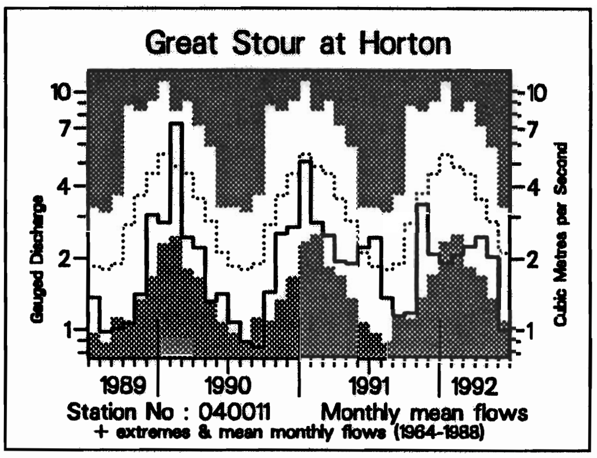
**FIGURE 1. MONTHLY RAINFALL FOR 1990-1992 AS A PERCENTAGE OF THE 1941-1970 AVERAGE**

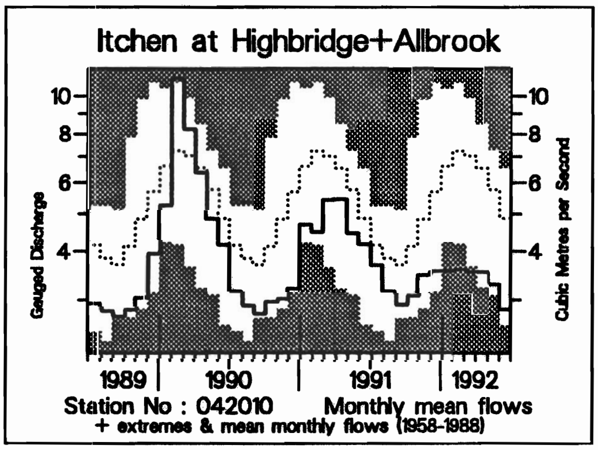


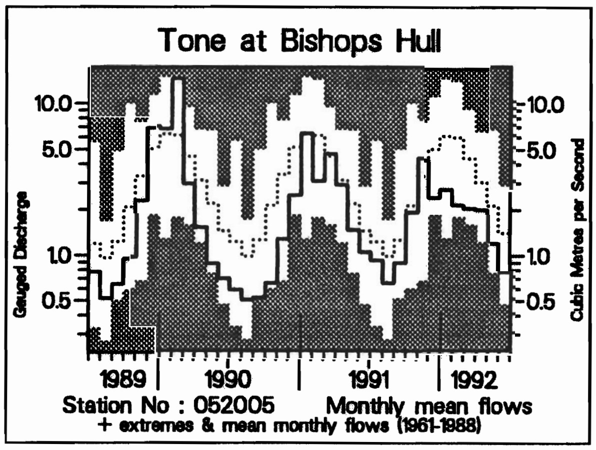
## FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS

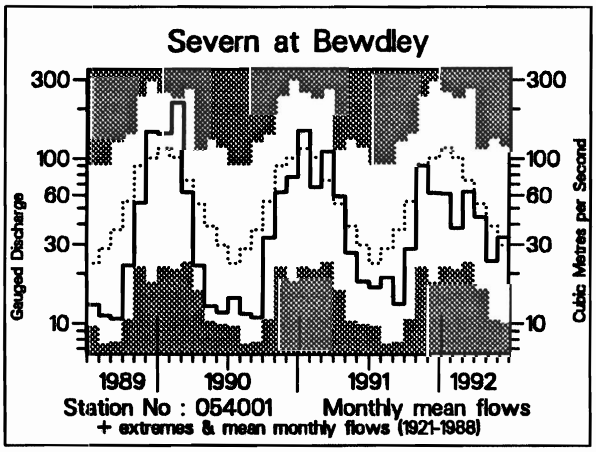


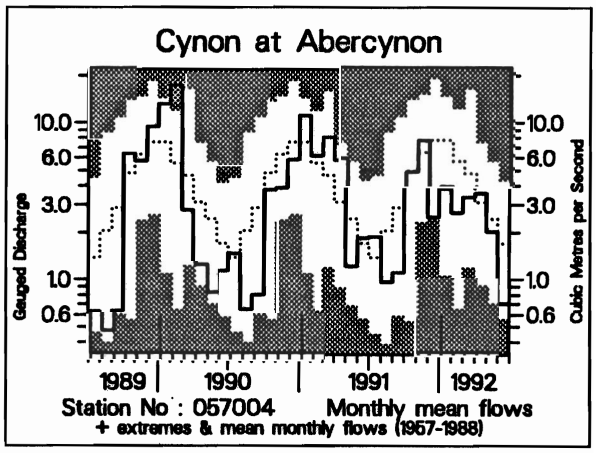

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1989
1990
1991
1992
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

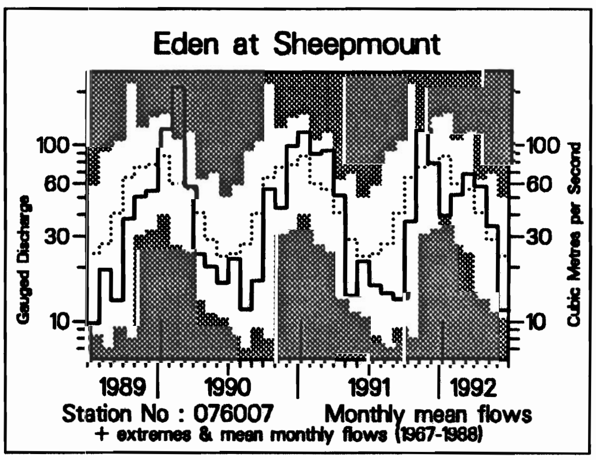

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10
7
4
2
1
1989
1990
1991
1992
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1988)

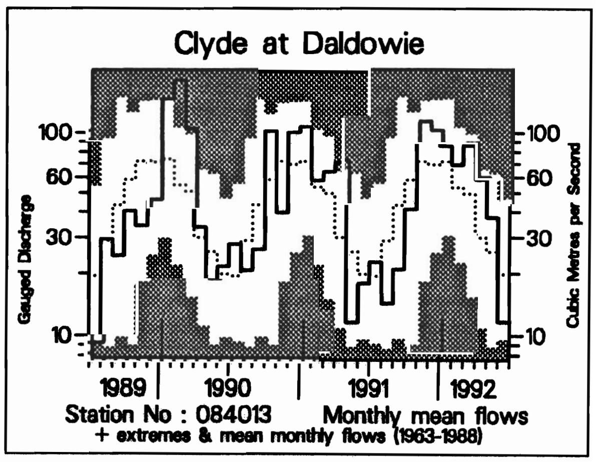

Itchen at Highbridge+Allbrook
Gauged Discharge
Cubic Metres per Second
10
8
6
4
1989
1990
1991
1992
Station No : 042010 Monthly mean flows
+ extremes & mean monthly flows (1958-1988)


Tone at Bishops Hull
Gauged Discharge
Cubic Metres per Second
10.0
5.0
1.0
0.5
1989
1990
1991
1992
Station No : 052005 Monthly mean flows
+ extremes & mean monthly flows (1961-1988)


Severn at Bewdley
Gauged Discharge
Cubic Metres per Second
300
100
60
30
10
1989
1990
1991
1992
Station No : 054001 Monthly mean flows
+ extremes & mean monthly flows (1921-1988)


Cynon at Abercynon
Gauged Discharge
Cubic Metres per Second
10.0
6.0
3.0
1.0
0.6
1989
1990
1991
1992
Station No : 057004 Monthly mean flows
+ extremes & mean monthly flows (1957-1988)


Eden at Sheepmount
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1989
1990
1991
1992
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1988)


Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1989
1990
1991
1992
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

# TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

| River/ Station name | Feb 1992 | Mar 1992 | Apr 1992 | May 1992 | Jun 1992 | | 1/92 to 6/92 | | 7/91 to 6/92 | | 7/90 to 6/92 | | 7/88 to 6/92 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mm %LT | mm %LT | mm %LT | mm %LT | mm %LT | rank /yrs | mm %LT | rank /yrs | mm %LT | rank /yrs | mm %LT | rank /yrs | mm %LT | rank /yrs |
| Dee at | 38 | 65 | 95 | 54 | 15 | 1 | 326 | 3 | 637 | 3 | 1390 | 4 | 2768 | 1 |
| Park | 52 | 68 | 123 | 87 | 40 | /20 | 76 | /20 | 81 | /19 | 88 | /18 | 86 | /16 |
| Tay at | 111 | 154 | 106 | 79 | 26 | 3 | 652 | 28 | 1214 | 30 | 2327 | 26 | 5355 | 35 |
| Ballathie | 97 | 121 | 125 | 115 | 58 | /40 | 111 | /40 | 107 | /39 | 103 | /38 | 119 | /36 |
| Whiteadder Water at | 21 | 41 | 79 | 16 | 9 | 4 | 205 | 7 | 301 | 6 | 754 | 8 | 1219 | 4 |
| Hutton Castle | 43 | 81 | 218 | 60 | 53 | /23 | 86 | /23 | 77 | /22 | 96 | /21 | 76 | /19 |
| South Tyne at | 62 | 100 | 105 | 36 | 8 | 1 | 352 | 11 | 729 | 13 | 1498 | 12 | 2900 | 5 |
| Haydon Bridge | 83 | 118 | 195 | 103 | 30 | /30 | 94 | /30 | 96 | /28 | 98 | /26 | 94 | /22 |
| Wharfe at | 49 | 96 | 64 | 32 | 10 | 5 | 311 | 11 | 602 | 7 | 1248 | 10 | 2570 | 5 |
| Flint Mill Weir | 64 | 126 | 118 | 86 | 40 | /37 | 85 | /37 | 83 | /36 | 86 | /35 | 88 | /33 |
| Derwent at | 15 | 18 | 40 | 14 | 8 | 1 | 111 | 4 | 168 | 3 | 442 | 4 | 841 | 1 |
| Buttercrambe | 38 | 44 | 129 | 59 | 48 | /31 | 57 | /31 | 52 | /30 | 67 | /29 | 63 | /27 |
| Trent at | 16 | 27 | 23 | 16 | 16 | 14 | 128 | 2 | 217 | 2 | 482 | 1 | 1083 | 2 |
| Colwick | 37 | 67 | 72 | 64 | 85 | /34 | 62 | /34 | 62 | /33 | 68 | /32 | 76 | /30 |
| Lud at | 8 | 10 | 10 | 10 | 9 | 3 | 57 | 2 | 102 | 2 | 208 | 1 | 527 | 1 |
| Louth | 24 | 28 | 32 | 38 | 45 | /24 | 33 | /24 | 41 | /23 | 42 | /22 | 52 | /20 |
| Witham at | 9 | 11 | 9 | 8 | 6 | 12 | 57 | 4 | 89 | 4 | 202 | 2 | 468 | 2 |
| Claypole Mill | 34 | 42 | 43 | 51 | 62 | /34 | 47 | /33 | 49 | /33 | 55 | /32 | 64 | /30 |
| Little Ouse at | 6 | 9 | 10 | 7 | 5 | 2 | 44 | 2 | 72 | 1 | 149 | 1 | 420 | 1 |
| Abbey Heath | 27 | 41 | 55 | 48 | 47 | /25 | 41 | /24 | 42 | /24 | 44 | /23 | 62 | /21 |
| Colne at | 5 | 8 | 7 | 5 | 4 | 9 | 35 | 4 | 59 | 4 | 121 | 2 | 351 | 1 |
| Lexden | 27 | 44 | 53 | 58 | 74 | /33 | 42 | /33 | 44 | /32 | 45 | /31 | 65 | /29 |
| Lee at | 4 | 5 | 6 | 4 | 5 | 13 | 29 | 3 | 58 | 3 | 139 | 3 | 429 | 5 |
| Feildes Weir (natr.) | 20 | 25 | 40 | 31 | 53 | /107 | 29 | /106 | 36 | /105 | 43 | /103 | 66 | /99 |
| Thames at | 12 | 12 | 20 | 11 | 9 | 30 | 77 | 8 | 130 | 8 | 270 | 5 | 699 | 6 |
| Kingston (natr.) | 36 | 39 | 89 | 63 | 71 | /110 | 50 | /110 | 53 | /109 | 55 | /108 | 71 | /106 |
| Coln at | 32 | 29 | 29 | 24 | 17 | 7 | 173 | 4 | 276 | 6 | 536 | 2 | 1206 | 2 |
| Bibury | 60 | 54 | 67 | 73 | 64 | /29 | 67 | /29 | 71 | /28 | 68 | /27 | 76 | /25 |
| Great Stour at | 15 | 17 | 18 | 15 | 7 | 1 | 87 | 2 | 175 | 1 | 371 | 1 | 763 | 1 |
| Horton | 45 | 51 | 69 | 71 | 45 | /27 | 52 | /26 | 60 | /25 | 63 | /23 | 64 | /19 |
| Itchen at | 25 | 26 | 25 | 24 | 20 | 2 | 148 | 1 | 293 | 1 | 633 | 1 | 1409 | 1 |
| Highbridge+Allbrook | 51 | 50 | 54 | 57 | 58 | /34 | 55 | /34 | 64 | /33 | 69 | /32 | 77 | /30 |
| Piddle at | 24 | 25 | 29 | 24 | 17 | 4 | 144 | 2 | 277 | 3 | 564 | 1 | 1231 | 1 |
| Baggs Mill | 41 | 44 | 68 | 76 | 73 | /29 | 56 | /28 | 70 | /27 | 70 | /25 | 76 | /21 |
| Exe at | 37 | 68 | 53 | 36 | 13 | 14 | 255 | 3 | 576 | 2 | 1295 | 4 | 2784 | 3 |
| Thorverton | 35 | 80 | 94 | 97 | 55 | /37 | 59 | /36 | 70 | /36 | 78 | /35 | 84 | /30 |
| Taw at | 34 | 45 | 40 | 28 | 8 | 12 | 194 | 3 | 443 | 2 | 1070 | 3 | 2387 | 3 |
| Umberleigh | 39 | 66 | 91 | 97 | 51 | /34 | 55 | /34 | 65 | /33 | 78 | /32 | 87 | /30 |
| Tone at | 27 | 27 | 26 | 16 | 10 | 3 | 141 | 2 | 284 | 2 | 608 | 1 | 1477 | 1 |
| Bishops Hull | 36 | 47 | 67 | 59 | 57 | /32 | 49 | /31 | 61 | /31 | 65 | /30 | 77 | /28 |
| Severn at | 22 | 39 | 26 | 15 | 20 | 55 | 159 | 7 | 299 | 6 | 686 | 8 | 1524 | 6 |
| Bewdley | 38 | 84 | 82 | 64 | 115 | /72 | 64 | /71 | 67 | /71 | 76 | /70 | 84 | /68 |
| Wye at | 132 | 317 | 128 | 113 | 41 | 9 | 876 | 16 | 1937 | 15 | 3939 | 9 | 8050 | 8 |
| Cefn Brwyn | 76 | 180 | 100 | 120 | 48 | /38 | 98 | /37 | 95 | /34 | 95 | /29 | 97 | /19 |
| Cynon at | 63 | 85 | 87 | 51 | 17 | 4 | 400 | 5 | 863 | 3 | 2109 | 5 | 4790 | 13 |
| Abercynon | 45 | 70 | 114 | 87 | 42 | /34 | 64 | /34 | 69 | /32 | 84 | /30 | 96 | /26 |
| Dee at | 102 | 246 | 113 | 83 | 40 | 10 | 698 | 7 | 1453 | 3 | 3084 | 3 | 6673 | 3 |
| New Inn | 60 | 137 | 106 | 128 | 68 | /23 | 86 | /23 | 81 | /23 | 86 | /22 | 92 | /20 |
| Eden at | 57 | 80 | 65 | 40 | 13 | 3 | 301 | 5 | 623 | 10 | 1352 | 9 | 2829 | 7 |
| Sheepmount | 76 | 114 | 141 | 126 | 51 | /22 | 86 | /22 | 91 | /20 | 99 | /18 | 103 | /14 |
| Clyde at | 90 | 121 | 79 | 53 | 16 | 8 | 480 | 28 | 909 | 24 | 1797 | 24 | 3608 | 24 |
| Daldowie | 119 | 161 | 182 | 155 | 61 | /29 | 131 | /29 | 118 | /28 | 116 | /27 | 118 | /25 |

Notes:
(i) Values based on gauged flow data unless flagged (natr.), when naturalised data have been used.
(ii) Values are ranked so that lowest runoff as rank 1.
(iii) %LT means percentage of long term average from the start of the record to 1991. For the long periods (at the right of this table), the end date for the long term is 1991.

# TABLE 4 START-MONTH RESERVOIR STORAGES UP TO JULY 1992

| Area | Reservoir (R)/ Group (G) | | Capacity● (Ml) | 1992 Feb | 1992 Mar | 1992 Apr | 1992 May | 1992 Jun | 1992 Jul | 1991 Jul |
|---|---|---|---|---|---|---|---|---|---|---|
| North West | Northern Command Zone[1] | (G) | 133375 | 70 | 80 | 94 | 93 | 86 | 66 | 65 |
| | Vyrnwy | (R) | 55146 | 86 | 88 | 100 | 100 | 94 | 89 | 91 |
| Northumbria | Teesdale[2] | (G) | 87936 | 88 | 89 | 96 | 97 | 89 | 71 | 61 |
| | Kielder | (R) | 199175* | 91* | 94* | 92* | 91* | 90* | 86* | 90* |
| Severn-Trent | Clywedog | (R) | 44922 | 88 | 85 | 99 | 99 | 97 | 93 | 99 |
| | Derwent Valley[3] | (G) | 39525 | 94 | 92 | 100 | 100 | 91 | 79 | 74 |
| Yorkshire | Washburn[4] | (G) | 22035 | 77 | 83 | 90 | 99 | 95 | 85 | 72 |
| | Bradford supply[5] | (G) | 41407 | 90 | 94 | 99 | 99 | 91 | 76 | 76 |
| Anglian | Grafham | (R) | 58707 | 90 | 88 | 95 | 96 | 96 | 95 | 96 |
| | Rutland | (R) | 130061 | 67 | 71 | 74 | 82 | 82 | 81 | 80 |
| Thames | London[6] | (G) | 206232 | 81 | 88 | 91 | 100 | 93 | 86 | 91 |
| | Farmoor [7] | (G) | 13843 | 99 | 97 | 84 | 100 | 98 | 98 | 100 |
| Southern | Bewl | (R) | 28170 | 58 | 54 | 62 | 70 | 73 | 71 | 76 |
| | Ardingly | (R) | 4730 | 92 | 89 | 100 | 100 | 100 | 100 | 100 |
| Wessex | Clatworthy | (R) | 5364* | 88* | 82* | 82* | 85* | 77* | 65* | 71* |
| | Bristol WW [8] | (G) | 38666* | 58* | 65* | 71* | 86* | 80* | 71* | 79* |
| South West | Colliford | (R) | 28540 | 82 | 81 | 80 | 82 | 80 | 71 | 89 |
| | Roadford | (R) | 34500 | 85 | 87 | 89 | 92 | 91 | 83 | 94 |
| | Wimbleball[9] | (R) | 21320 | 76 | 77 | 79 | 79 | 76 | 63 | 75 |
| | Stithians | (R) | 5205 | 38 | 45 | 52 | 65 | 69 | 61 | 77 |
| Welsh | Celyn + Brenig | (G) | 131155 | 93 | 97 | 100 | 100 | 100 | 99 | 94 |
| | Brianne | (R) | 62140 | 97 | 100 | 100 | 100 | 97 | 88 | 93 |
| | Big Five[10] | (G) | 69762 | 93 | 92 | 97 | 98 | 92 | 77 | 94 |
| | Elan Valley[11] | (G) | 99106 | 91 | 100 | 100 | 100 | 96 | 91 | 91 |
| Lothian | Edinburgh/Mid Lothian | (G) | 97639 | 92 | 96 | 100 | 100 | 98 | 87 | 86 |
| | West Lothian | (G) | 5613 | 82 | 91 | 94 | 85 | 76 | 60 | 77 |
| | East Lothian | (G) | 10206 | 98 | 98 | 99 | 89 | 91 | 81 | 91 |

● Live or usable capacity (unless indicated otherwise)
* Gross storage/percentage of gross storage

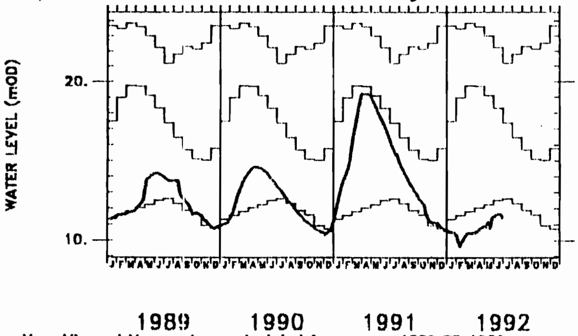
1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6. Lower Thames (includes Queen Mother, Wraysbury, Queen Mary, King George VI and Queen Elizabeth II) and Lee Valley (includes King George and William Girling) groups - pumped storages.
7. Farmoor 1 and 2 - pumped storages.
8. Blagdon, Chew Valley and others.
9. Shared between South West (river regulation for abstraction) and Wessex (direct supply).
10. Usk, Talybont, Llandegfedd (pumped storage), Taf Fechan, Taf Fawr.
11. Claerwen, Caban Coch, Pen y Garreg and Craig Goch.

Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient use of water stocks will further affect reservoir storages. Table 4 provides a link between the hydrological conditions described elsewhere in the report and the water resources situation.

# FIGURE 3 GROUNDWATER HYDROGRAPHS

Site name: DALTON HOLME

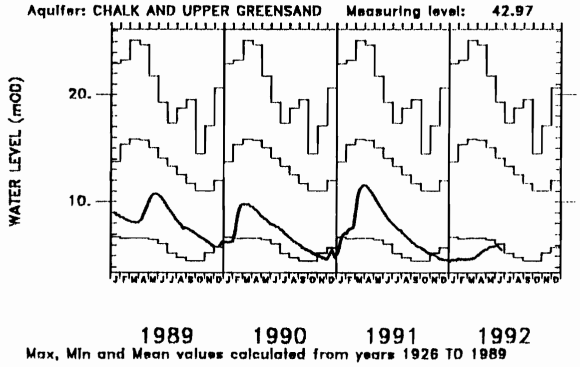
National grid reference: SE 9651 4530 Well number: SE94/5
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 34.50




Max, Min and Mean values calculated from years 1889 TO 1989

Site name: LITTLE BROCKLESBY

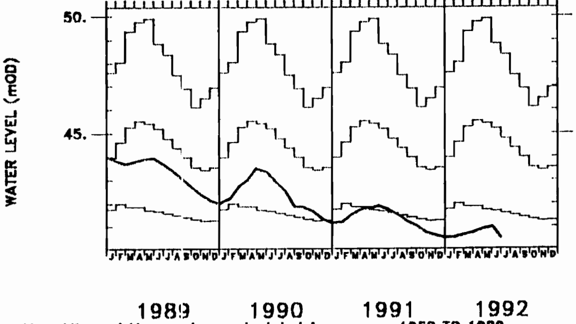
National grid reference: TA 1371 0888 Well number: TA10/40
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 42.97




Max, Min and Mean values calculated from years 1926 TO 1989

Site name: WASHPIT FARM

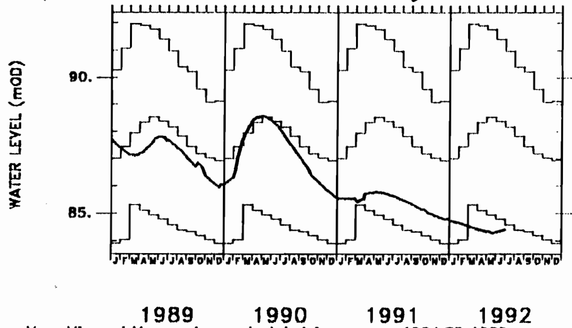
National grid reference: TF 8138 1960 Well number: TF81/2
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 80.20




Max, Min and Mean values calculated from years 1950 TO 1989

Site name: THE HOLT

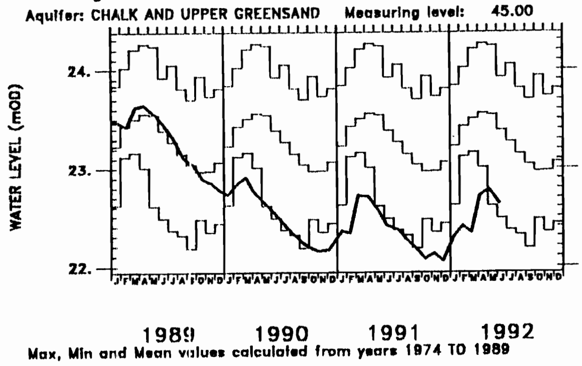
National grid reference: TL 1692 1965 Well number: TL11/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 138.17




Max, Min and Mean values calculated from years 1964 TO 1989

Site name: FAIRFIELDS

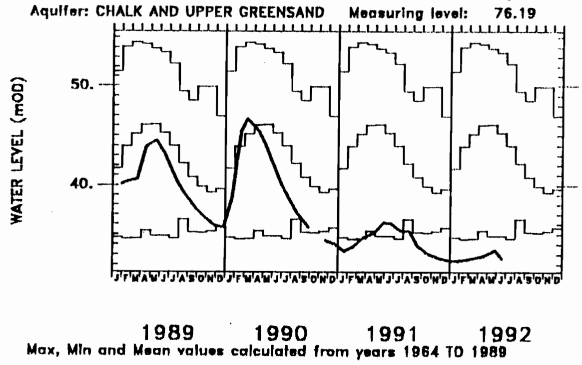
National grid reference: TM 2461 6109 Well number: TM26/46
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 45.00




Max, Min and Mean values calculated from years 1974 TO 1989

Site name: REDLANDS HALL,ICKLETON

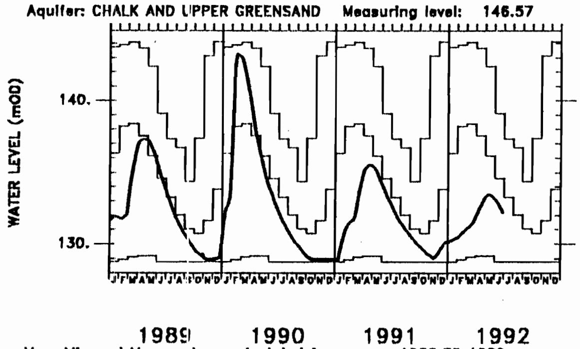
National grid reference: TL 4522 4182 Well number: TL44/12
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 76.19




Max, Min and Mean values calculated from years 1964 TO 1989

Site name: ROCKLEY

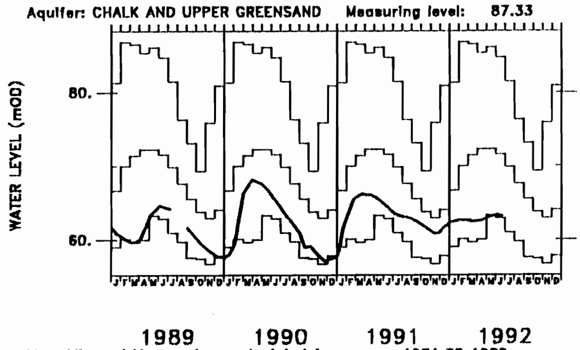
National grid reference: SU 1655 7174 Well number: SU17/57
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.57




Max, Min and Mean values calculated from years 1933 TO 1989

Site name: LITTLE BUCKET FARM,WALTHAM

National grid reference: TR 1225 4690 Well number: TR14/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 87.33

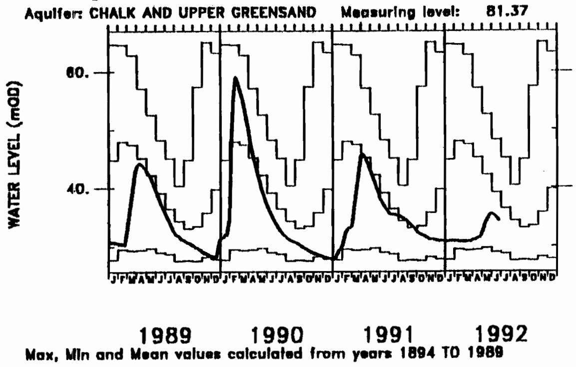



Max, Min and Mean values calculated from years 1971 TO 1989

Site name: COMPTON HOUSE

National grid reference: SU 7755 1490 Well number: SU71/23

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37

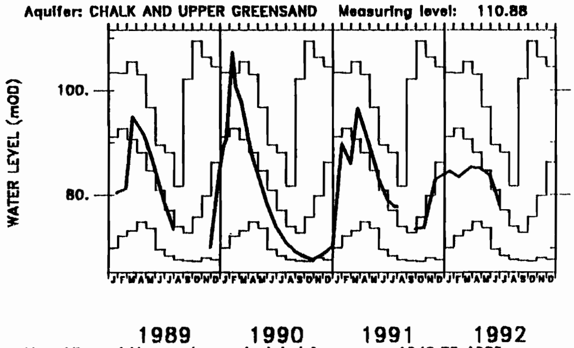



Max, Min and Mean values calculated from years 1894 TO 1989

Site name: WEST WOODYATES MANOR

National grid reference: SU 0160 1960 Well number: SU01/5B

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 110.88

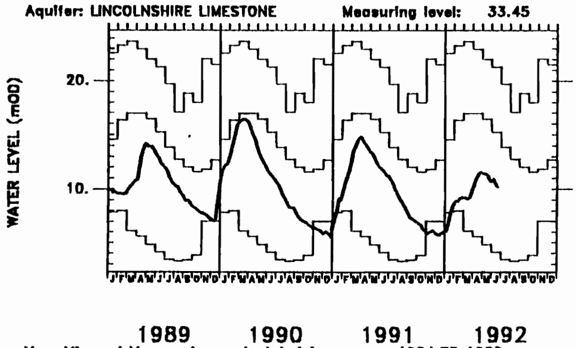



Max, Min and Mean values calculated from years 1942 TO 1989

Site name: NEW RED LION

National grid reference: TF 0885 3034 Well number: TF03/37

Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.45

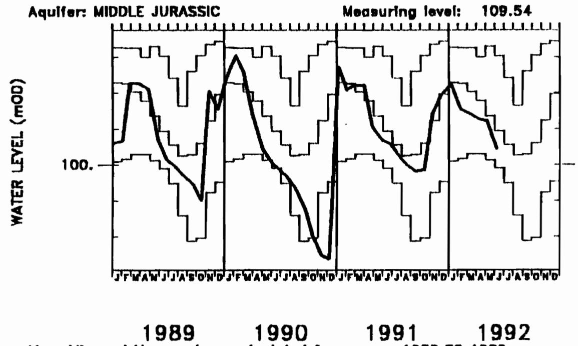



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: AMPNEY CRUCIS

National grid reference: SP 0595 0190 Well number: SP00/62

Aquifer: MIDDLE JURASSIC Measuring level: 109.54

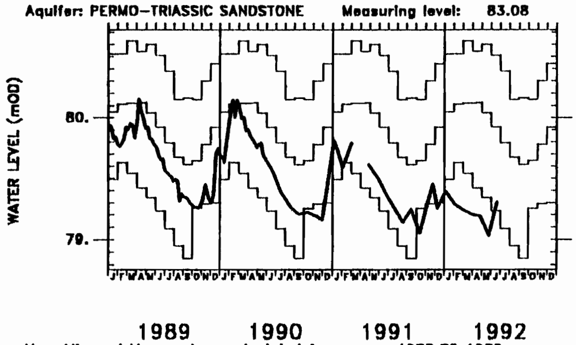



Max, Min and Mean values calculated from years 1958 TO 1989

Site name: LLANFAIR DC

National grid reference: SJ 1374 5556 Well number: SJ15/15

Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 83.08

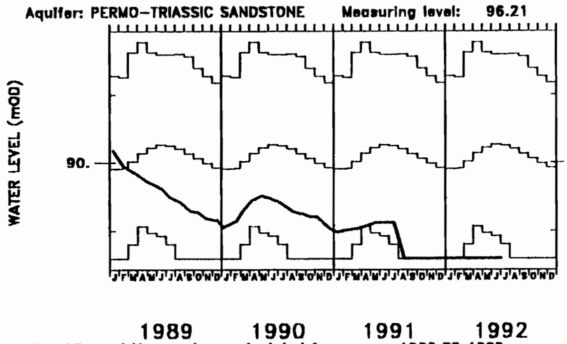



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: WEEFORD FLATS,WEEFORD

National grid reference: SK 1440 0464 Well number: SK10/9

Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 96.21

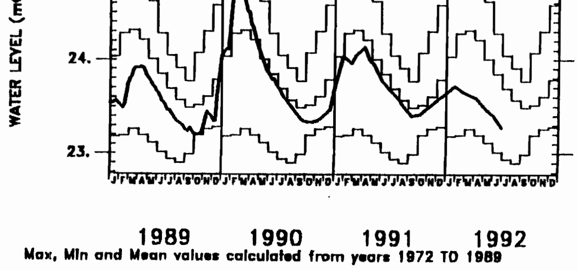



Max, Min and Mean values calculated from years 1966 TO 1989

Site name: BUSSELS NO.7A

National grid reference: SX 9528 9872 Well number: SX99/37B

Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.97

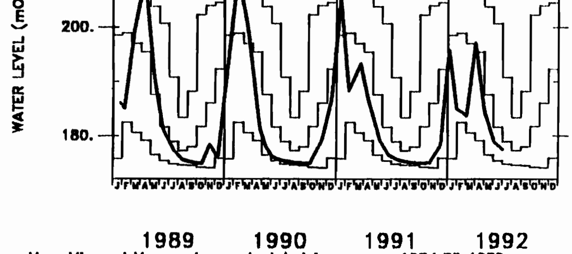



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: ALSTONFIELD

National grid reference: SK 1292 5547 Well number: SK15/16

Aquifer: CARBONIFEROUS LIMESTONE Measuring level: 280.25




Max, Min and Mean values calculated from years 1974 TO 1989

TABLE 5 A COMPARISON OF JUNE GROUNDWATER LEVELS : 1992, 1991 AND 1976

| Site | Aquifer | Records commence | Average June Level | June 1976 Day | June 1976 Level | June 1991 Day | June 1991 Level | June and July 1992 Day | June and July 1992 Level | No of years June/July levels <1992 | Lowest pre-1992 level (any month) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Wetwang | C & UGS | 1971 | 22.29 | 24/06 | 19.30 | 30/06 | 20.05 | 30/06 | 19.15 | 2 | 16.84 |
| Dalton Holme | C & UGS | 1889 | 18.31 | 26/06 | 13.69 | 26/06 | 16.64 | 30/06 | 11.40 | 0 | 10.34 |
| Little Brocklesby | C & UGS | 1926 | 14.07 | 04/06 | 6.23 | 04/06 | 9.02 | 23/06 | 5.57 | 0 | 4.54 |
| Washpit Farm | C & UGS | 1950 | 45.20 | 01/06 | 42.70 | 04/06 | 41.88 | 01/07 | 40.51 | 0 | 41.24 |
| The Holt | C & UGS | 1964 | 88.38 | 17/06 | 85.52 | 30/06 | 85.65 | 01/07 | 84.40 | 0 | 83.90 |
| Therfield Rectory | C & UGS | 1883 | 81.97 | 30/06 | 74.78 | 30/06 | 73.97 | 14/06 | 71.95 | 3 | dry (below 71.60) |
| Fairfields | C & UGS | 1974 | 23.39 | 22/06 | 22.78 | 11/06 | 22.41 | 09/06 | 22.63 | 3 | 22.05 |
| Redlands Farm | C & UGS | 1964 | 45.27 | 01/06 | 37.70 | 24/06 | 36.09 | 19/06 | 32.64 | 0 | 32.46 |
| Rockley | C & UGS | 1933 | 134.60 | 27/06 | 128.91 | 30/06 | 132.86 | 28/06 | 132.18 | >10 | dry (below 128.94) |
| Little Bucket Farm | C & UGS | 1971 | 71.54 | 02/06 | 62.83 | 24/06 | 64.07 | 22/06 | 63.12 | 1 | 56.77 |
| Compton House | C & UGS | 1894 | 39.10 | 30/06 | 29.06 | 25/06 | 36.04 | 25/06 | 34.27 | >10 | 27.64 |
| Chilgrove House | C & UGS | 1836 | 46.95 | 26/06 | 36.91 | 25/06 | 44.51 | 25/06 | 43.37 | >10 | 33.46 |
| West Dean No 3 | C & UGS | 1940 | 1.65 | 25/06 | 1.21 | 07/06 | 1.39 | 26/06 | 1.43 | >10 | 1.01 |
| Lime Kiln Way | C & UGS | 1969 | 125.40 | 15/06 | 124.37 | 19/06 | 124.81 | 16/06 | 123.97 | 0 | 124.09 |
| Ashton Farm | C & UGS | 1974 | 67.90 | 21/06 | 64.78 | 01/06 | 67.80 | 01/07 | 66.60 | 4 | 63.10 |
| West Woodyates | C & UGS | 1942 | 80.89 | 01/06 | 70.75 | 01/06 | 83.20 | 01/07 | 77.90 | >10 | 67.62 |
| New Red Lion | LLst | 1964 | 15.25 | 25/06 | 4.11 | 18/06 | 11.53 | 22/06 | 10.22 | 2 | 3.29 |
| Ampney Crucis | Mid Jur | 1958 | 100.93 | 27/06 | 99.89 | 28/06 | 100.56 | 08/06 | 100.42 | >10 | 97.38 |
| Dunmurry (NI) | PTS | 1985 | 28.18 | no | levels | 25/06 | 27.85 | 25/06 | 27.93 | 2 | 27.47 |
| Llanfair DC | PTS | 1972 | 79.92 | 01/06 | 79.23 | 23/06 | 79.38 | 22/06 | 79.30 | 1 | 78.85 |
| Morris Dancers | PTS | 1969 | 32.58 | 22/06 | 31.92 | 10/06 | 32.01 | 06/07 | 31.94 | 1 | 30.87 |
| Weeford Flats | PTS | 1966 | 90.26 | 17/06 | 88.93 | 06/06 | 89.12 | 03/07 | dry | 0 | dry (below 88.61) |
| Bussels 7A | PTS | 1972 | 23.85 | 29/06 | 23.01 | 06/06 | 23.77 | 30/06 | 23.27 | 1 | 22.90 |
| Rusheyford NE | MgLst | 1967 | 76.22 | 29/06 | 65.81 | 03/06 | 75.58 | 04/06 | 74.75 | >10 | 64.77 |
| Peggy Ellerton | MgLst | 1968 | 34.77 | 22/06 | 31.38 | 11/06 | 33.39 | 08/06 | 31.68 | 1 | 31.10 |
| Alstonfield | CLst | 1974 | 181.61 | 28/06 | 175.45 | 24/06 | 176.55 | 03/07 | 177.53 | 8 | 174.22 |

Groundwater levels are in metres above Ordnance Datum

| | |
|---|---|
| C & UGS | Chalk and Upper Greensand |
| LLst | Lincolnshire Limestone |
| PTS | Permo-Triassic sandstones |
| Mid Jur | Middle Jurassic limestones |
| MgLst | Magnesian Limestone |
| CLst | Carboniferous Limestone |

## FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS